

Small-Angle Neutron Scattering From Heavy Water in the Vicinity of the Critical Point: A Study of the Parametric State Equation and of the Intermolecular Correlations

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Owing to the high values of the critical coordinates of water ($T_c = 370.74^\circ\text{C}$, $P_c = 216.6$ bar for D_2O) the study of water near the critical point by neutron scattering has been hampered by technical problems [1]. We will present small-angle neutron scattering (SANS) spectra of heavy water measured for wave number transfers, q , up to 0.36 \AA^{-1} . These spectra were recorded along a near critical isochore at temperatures between ($T_c + 1.64 \text{ K}$) and ($T_c + 22.02 \text{ K}$), where T_c is the critical temperature, and along two near-critical isotherms ($T_c + 1.16 \text{ K}$) and ($T_c + 2.20 \text{ K}$) by varying the density between $-0.060 \text{ g cm}^{-3} < (\rho - \rho_c) < 0.075 \text{ g cm}^{-3}$, where ρ_c is the critical density.

As expected, a pronounced increase of the coherent scattered intensity is observed at small q values due to the divergence of the isothermal compressibility at the critical point. The analysis of the data shows that the spectra can be accurately described by the Fisher-Langer scaling function over the investigated q range provided that a multiplicative additional term describing short-range correlations between water molecules is taken into account [2]. The off-critical spectra are analysed using the parametric state equation with appropriate corrections-to-scaling [3]. The data show that the asymmetry of the system is more pronounced for density values larger than the critical one.

- [1] M. Bonetti and P. Calmettes, *Rev. Sci. Instrum.* **70**, 4015 (1999).
- [2] M. Bonetti, G. Romet-Lemonne, P. Calmettes, and M.-C. Bellissent-Funel, *J. Chem. Phys.* **111**, (1999).
- [3] M. Bonetti, P. Calmettes, and C. Bervillier, submitted to *J. Chem. Phys.*